CLAIMS

THAT WHICH IS CLAIMED:

1. A method of recovering information encoded in a spread spectrum signal transmitted in a communications medium, the method comprising:

receiving at least one multipath version of a composite signal including the spread spectrum signal from the communications medium;

selecting a set of time-offsets;

correlating the composite signal with a spreading sequence at each of the time-offsets in the set of time-offsets to produce a first set of time-offset correlations of the composite signal with the spreading sequence;

estimating noise correlation among the time-offset correlations to produce noise correlation estimates;

selecting a subset of the time-offsets from the set of time-offsets based on the noise correlation estimates;

correlating the composite signal with a traffic spreading sequence at each of the time-offsets in the selected subset of the time-offsets to produce a plurality of traffic correlations; and

combining the plurality of traffic correlations using a weighted combination to estimate information encoded in the transmitted spread spectrum signal.

2. The method of Claim 1, wherein the set of time-offsets selected comprise time-offsets corresponding to the times at which the multipath versions of the composite signal are received.

3. The method of Claim 2, wherein the set of time-offsets selected further comprise time-offsets at a fixed distance in time from the times at which multipath versions of the composite signal are received.

4. The method of Claim 2, wherein the set of time-offsets selected further comprise time-offsets at integer multiples of a fixed distance in time from the times at which multipath versions of the composite signal are received.

5. The method of Claim 4, wherein the fixed distance is an integer multiple of one quarter the value of the modulation chip period of the spread spectrum signal.

6. The method of Claim 1, wherein selecting a subset of the time-offsets from the set of time-offsets based on the noise correlation estimates comprises:

determining a performance metric that is associated with each of a plurality of subsets of the first set of time-offset correlations; and

selecting as the subset of the time offsets the time offsets corresponding to one of the plurality of the subsets of the first set of time-offset correlations that has a performance metric meeting a predetermined criterion.

7. The method of Claim 6, wherein each of the plurality of subsets of the first set of time-offset correlations comprises the same number of members, and wherein the number of members is predetermined.

8. The method of Claim 6, further comprising determining the number of multipaths of the composite signal that are received from the communications medium, and wherein the number of members in each of the plurality of subsets of the first set of time-offset correlations is determined as a function of the number of multipaths of the composite signal received.

9. The method of Claim 6, wherein each of the plurality of subsets of the first set of time-offset correlations comprises the same number of members, and wherein the number of members is adaptively selected based on the improvement in the value of the performance metric provided by successive increases in the number of members.

10. The method of Claim 6, wherein the performance metric is a signal-to-noise ratio.

11. The method of Claim 6, wherein determining a performance metric that is associated with each of a plurality of subsets of the first set of time-offset correlations comprises determining the performance metric that results from the weighted combinations of each distinct subset of different time-offset correlations in the first set of time-offset correlation that has a specific number of members.

12. The method of Claim 6, wherein determining a performance metric that is associated with each of a plurality of subsets of the first set of time-offset correlations comprises:

creating a first group of time-offset correlations that comprises the time-offset correlations that are aligned in time with at least some of the multipath versions of the composite signal received;

determining values for the performance metric that result from the weighted combinations of each distinct subset of different time-offset correlations having a specific number of members that comprises the time-offset correlations in the first group of time-offset correlations.

13. The method of Claim 6, wherein selecting as the subset of the time offsets the time offsets corresponding to one of the plurality of the subsets of the first set of time-offset correlations that has a performance metric meeting a predetermined criterion comprises using an ordered search to identify time-offsets corresponding to the subset of the first set of time-offset correlations that has a specific number of members and a weighted combination that maximizes the performance metric.

14. The method of Claim 13, wherein the ordered search comprises:

identifying as a first time-offset the time-offset corresponding to the time-offset correlation that maximizes the performance metric for the case where the number of members in the subset of the plurality of time-offset correlations is equal to one; and then

identifying as a second time-offset the time-offset corresponding to the time-offset correlation that when combined in a weighted combination with the time-offset correlation having the first time-offset maximizes the performance metric for the case where the number of members in the subset of the plurality of time-offset correlations is equal to two; and then

identifying as a third time-offset the time-offset corresponding to the time-offset correlation that when combined in a weighted combination with the time-offset correlations having the first and second time-offsets maximizes the performance metric for the case where the number of members in the subset of the plurality of time-offset correlations is equal to three; and then

continuing to sequentially identify additional time-offsets by sequentially identifying as another time-offset the time-offset corresponding to the time-offset correlation that when combined in a weighted combination with the time-offset correlations having the already identified time-offsets maximizes the performance metric, until a desired number of time-offsets have been identified.

15. The method of Claim 13, wherein the ordered search comprises a constrained ordered search wherein initially at least some of the time-offsets that are aligned in time with received multipath versions of the composite signal are selected as part of the subset of the time-offsets.

16. The method of Claim 2, wherein the set of time-offsets selected further comprise time-offsets at intervals shifted both forward and backwards in time from the times at which multipath versions of the composite signal are received by the differential delay between two multipath signals received from an interference source.

17. The method of Claim 2, wherein the set of time-offsets selected further comprise time-offsets corresponding to the times at which multipath versions of a second composite signal are received.

18. The method of Claim 3, wherein the set of time-offsets selected further comprise time-offsets corresponding to:

the times at which multipath versions of a second composite signal are received; and

shifts in time from the times at which multipath versions of the second composite signal are received.

19. The method of Claim 6, wherein the weights used to form the weighted combination are generated based on the noise correlation estimates and the estimated net channel response of the time-offset correlations in the first set of time-offset correlations.

20. The method of Claim 19, wherein the noise correlation estimates comprises a noise correlation matrix, and wherein off-diagonal elements in the noise correlation matrix are modified to reduce estimation noise.

21. The method of Claim 20, wherein the modification to the noise correlation matrix comprises setting off-diagonal elements of the matrix to zero that are less than a predetermined threshold.

22. The method of Claim 20, wherein the modification to the noise correlation matrix comprises subtracting a fixed amount from all off-diagonal elements of the matrix.

23. The method of Claim 20, wherein the modification to the noise correlation matrix comprises scaling all off-diagonal elements of the matrix by a value between zero and one.

24. The method of Claim 20, wherein the modification to the noise correlation matrix comprises a non-linear operation that reduces off-diagonal elements of the matrix having small values by different amounts than off-diagonal elements having larger values.

25. A method of recovering information encoded in a spread spectrum signal transmitted in a communications medium, the method comprising:

receiving at least one multipath version of a composite signal including the spread spectrum signal from the communications medium;

selecting a set of time-offsets based at least in part on the times at which multipath versions of an interfering signal are received;

correlating the composite signal with a spreading sequence based on the selected set of time-offsets to produce a plurality of time-offset correlations of the composite signal with the spreading sequence;

estimating noise correlation among the plurality of time-offset correlation to produce noise correlation estimates;

selecting a subset of the set of time-offsets based on the noise correlation estimates;

correlating the composite signal with a traffic spreading sequence at each of the time-offsets in the selected subset of the time-offsets to produce a plurality of traffic correlations; and

combining the plurality of traffic correlations using a weighted combination to estimate information encoded in the transmitted spread spectrum signal.

26. The method of Claim 25, wherein the set of time-offsets selected further comprise time offsets corresponding to the times at which multipath versions of the composite signal are received.

27. The method of Claim 26, wherein selecting a set of time-offsets based at least in part on the times at which multipath versions of an interfering signal are received further comprises selecting time-offsets corresponding to:

the time at which at least one multipath version of the composite signal is received plus the differential delay between at least one distinct pair of multipath signals received from an interference source; and

the time at which at least one multipath version of the composite signal is received minus the differential delay between at least one distinct pair of multipath signals received from an interference source.

28. A method of recovering information encoded in a spread spectrum signal transmitted in a communications medium, the method comprising:

receiving at least one multipath version of a composite signal including the spread spectrum signal from the communications medium;

selecting a set of time-offsets, wherein the set of time-offsets comprises a set of desired signal offsets that correspond to the times at which multipath versions of the composite signal are received, and a set of noise probing offsets that are integer multiple offsets of a predetermined value from the desired signal offsets;

correlating the composite signal with a spreading sequence at each of the time-offsets in the selected set of time-offsets to produce a plurality of time-offset correlations of the composite signal with the spreading sequence;

estimating noise correlation among the plurality of time-offset correlations to produce noise correlation estimates;

selecting a subset of the set of time-offsets based on the noise correlation estimates;

correlating the composite signal with a traffic spreading sequence at each of the time-offsets in the selected subset of the time-offsets to produce a plurality of traffic correlations; and

combining the plurality of traffic correlations using a weighted combination to estimate information encoded in the transmitted spread spectrum signal.

29. The method of Claim 28, wherein the set of time-offsets selected further comprises time-offsets that are shifted both forwards and backwards in time from each of the time-offsets in the set of desired signal offsets by the differential delays between each distinct pair of multipath signals received from an interference source.

30. A wireless terminal, comprising:

a transmitter;

a receiver;

a user interface coupled to the transmitter and the receiver;

an antenna coupled to the transmitter and the receiver;

a correlation timing determiner circuit that selects a set of correlation times based on the times at which multipath versions of a desired signal are received;

a correlation circuit, operatively associated with the correlation timing determiner and responsive to a received composite signal, that generates respective time-offset correlations of the composite signal with a sequence at respective correlation times of the selected set of correlation times;

a noise correlation estimation circuit that estimates noise correlation;

a combining finger selector circuit that selects a subset of the correlation times based on the noise correlation estimates; and

a combiner circuit that combines correlations of the composite signal at the selected subset of the correlation times with a traffic spreading sequence to produce an estimate of information contained in the composite signal.

31. The wireless terminal according to Claim 30, wherein the correlation timing determiner circuit selects correlation times at the times at which each multipath version of the composite signal are received.

32. The wireless terminal according to Claim 31, wherein the correlation timing determiner circuit further selects correlation times that are offset by a fixed value from the times at which each multipath version of the composite signal is received.

33. The wireless terminal according to Claim 30, wherein the combining finger selector circuit is configured to select a subset of the correlation times by determining the value of the weighted combination of each distinct subset of a specified number of different time-offset correlations, and selecting the subset of time-offset correlations having the highest value.

34. The wireless terminal according to Claim 30, wherein the combining finger selector circuit is configured to:

select a first group of time-offset correlations that correspond to the time-offsets that are aligned in time with the M strongest received multipath versions of the composite signal; and

determining the value of the weighted combination of each distinct subset of a specified number of different time-offset correlations that comprises the time-offset correlations in the first group of time-offset correlations and selecting from these subsets the subset of time-offset correlations having the highest value of the weighted combination.

35. The wireless terminal according to Claim 30, wherein the combining finger selector circuit is configured to select a subset of the correlation times using an ordered search to identify the subset of a specified number of the plurality of time-offset correlations having a weighted combination that maximizes a performance metric.

36. A system for recovering information encoded in a spread spectrum signal transmitted in a communications medium, comprising:

means for receiving at least one multipath version of a composite signal including the spread spectrum signal from the communications medium;

means for selecting a set of time-offsets;

means for correlating the composite signal with a spreading sequence at each of the time-offsets in the set of time-offsets to produce a first set of time-offset correlations of the composite signal with the spreading sequence;

means for estimating noise correlation among the time-offset correlations to produce noise correlation estimates;

means for selecting a subset of the time-offsets from the set of time-offsets based on the noise correlation estimates;

means for correlating the composite signal with a traffic spreading sequence at each of the time-offsets in the selected subset of the time-offsets to produce a plurality of traffic correlations; and

means for combining the plurality of traffic correlations using a weighted combination to estimate information encoded in the transmitted spread spectrum signal.

37. The system of Claim 36, wherein the means for selecting a set of time-offsets comprises means for selecting time-offsets corresponding to the times at which multipath versions of the composite signal are received.

38. The system of Claim 37, wherein the means for selecting a set of time-offsets further comprises means for selecting time-offsets a distance d in time from the times at which multipath versions of the composite signal are received.

39. The system of Claim 36, wherein the means for selecting a subset of the time-offsets from the set of time-offsets comprises:

means for determining a performance metric that is associated with each of a plurality of subsets of the first set of time-offset correlations; and

means for selecting as the subset of the time offsets the time offsets corresponding to one of the plurality of the subsets of the first set of time-offset correlations that has a performance metric meeting a predetermined criterion.

40. The system of Claim 37, wherein the means for selecting a set of time-offsets further comprises means for selecting time-offsets at intervals shifted both forward and backwards in time from the times at which multipath versions of the composite signal are received by the differential delay between two multipath signals received from an interference source.

41. The system of Claim 37, wherein the means for selecting a set of time-offsets further comprises means for selecting time-offsets corresponding to the times at which multipath versions of a second composite signal are received.

42. The method of Claim 10, wherein the signal-to-noise ratio is determined using a set of channel estimates and the noise correlation estimates.

43. A receiver, comprising:

a receiver;

a correlation timing determiner circuit that selects a set of correlation times based on the times at which multipath versions of a desired signal are received;

a correlation circuit, operatively associated with the correlation timing determiner and responsive to a received composite signal, that generates respective time-offset correlations of the composite signal with a sequence at respective correlation times of the selected set of correlation times;

a noise correlation estimation circuit that estimates noise correlation;

a combining finger selector circuit that selects a subset of the correlation times based on the noise correlation estimates; and

a combiner circuit that combines correlations of the composite signal at the selected subset of the correlation times with a traffic spreading sequence to produce an estimate of information contained in the composite signal.

44. The receiver according to Claim 43, wherein the correlation timing determiner circuit selects correlation times at the times at which each multipath version of the composite signal are received.

45. The receiver according to Claim 44, wherein the correlation timing determiner circuit further selects correlation times that are offset by a fixed value from the times at which each multipath version of the composite signal is received.

46. The receiver according to Claim 43, wherein the combining finger selector circuit is configured to select a subset of the correlation times by determining the value of the weighted combination of each distinct subset of a specified number of different time-offset correlations, and selecting the subset of time-offset correlations having the highest value.

47. The receiver according to Claim 43, wherein the combining finger selector circuit is configured to:

select a first group of time-offset correlations that correspond to the time-offsets that are aligned in time with the M strongest received multipath versions of the composite signal; and

determining the value of the weighted combination of each distinct subset of a specified number of different time-offset correlations that comprises the time-offset correlations in the first group of time-offset correlations and selecting from these subsets the subset of time-offset correlations having the highest value of the weighted combination.

48. The receiver according to Claim 43, wherein the combining finger selector circuit is configured to select a subset of the correlation times using an ordered search to identify the subset of a specified number of the plurality of time-offset correlations having a weighted combination that maximizes a performance metric.